

## PŮVODNÍ PRÁCE

awarded the highest academic honour – an honorary doctorate by the Senate of the Academy of Physical Education in Wrocław on 22 Nov 1998 and the Senate of the Academy of Physical Education in Poznań on 15 April 2004.

Promoter, prof. Wiesław Osinski in the eulogy for professor Kazimierz Zbigniew Drozdowski at the presentation of Honorary Doctor at the Academy of Physical Education in Poznań (Drozdowski, 2003) said, “I think Professor Zbigniew Drozdowski can and should be seen as the heir of the enlightened minds of the greatest scholar who at the beginning of the twentieth century, in a courageous, ardent and tireless way argued the need to create academic education and develop scientific research into physical education first, and later motor rehabilitation, sport, recreation and tourism. Professor, today you are certainly a great authority as a man of science, an original and versatile thinker, encompassing various areas of the most important generalizations in the sciences of physical culture. We admire you, professor, as an expert, researcher and co-founder of Polish physical anthropology, active in its various areas, worried about the ethical foundations of science, conscious of challenges and threats facing the civilization and culture at the beginning of the twenty-first century”. In his professional life professor valued academic tradition, seriousness and ethos of higher education the most. Honos habet onus, honour is burdened with responsibility – Professor seemed to think and say.

In the world of anthropology and physical culture, professor Zbigniew Drozdowski is viewed with respect and appreciation for his diligence, fairness, objectivity, tact, and above all for the great personal kindness and modesty.

## Literature

JANUSZ A., Doktorat honoris causa AWF we Wrocławiu dla profesora Zbigniewa Drozdowskiego. *Anthropological Review*, 1998, vol. 61, pp. 117–118.

Zbigniew Kazimierz Drozdowski doktor honoris causa Akademii Wychowania Fizycznego im. Eugeniusza Piaseckiego w Poznaniu. AWF, Poznań 2003.

ZIÓŁKOWSKA-ŁAJPE., Zbigniew Drozdowski (1930–2004). *European Anthropological Association*, 2004, vol. 4, p. 25.

## BIRTH BODY MASS AND OBESITY OF CHILDREN AT KINDERGARTEN AGE

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## Abstract

Fetus age is the most precise criteria describing the matter of biological maturity of newborn (Kornafel, 1995). Proper pregnancy, directly combined with undisturbed progression of fetus lasts for 270–280 day and ends up with birth of healthy child. One of the most important stages of ontogenesis is passing the birth selection boundary, understood as birth of a healthy newborn baby, capable of all basic life functions as well as body dimensions and mass growth proper to biological age in the stage of progressive development.

The aim of this work is the estimation of dependence between birth body mass with the level of obesity among children at kindergarten age.

Research material consists of retrospective data gathered from health registers and measurements done in 2007 among 62 girls and 58 boys at the age from 3 to 6 in one of Poznań kindergartens (Poland). The level of biological development was estimated on the basis of researched morphologic characteristics values, while the state of birth maturity was described by fetus maturity and birth body mass.

Significant differentiation of physical development was stated among researched children concerning the birth maturity. Conducted analyzes show, that the element conditioning obesity of children at kindergarten age is the advanced biological maturity which is the result of fetus development time period.

**Key words:** biological maturity, children obesity, birth body mass, gestation age

## Introduction

From the point of view of physical development the process involving an increase in body weight and dimensions is defined as growth. As a result, it is a manifestation of external effects of ontogenetic development process (differentiation, maturation), which can be defined in terms of numbers. One of the most important stages of ontogenesis is passing the birth selection threshold, defined as a birth of a mature newborn, able to independently undertake the basic life functions and increases of body weight and dimensions appropriate for the biological age in the stage of progressive development.

The authors point the appearance of too low birth mass of newborn as well as significant overweight at moment of birth (Falk et al., 1989; Fuchsová et al., 2008).

For a few decades a significant increase in occurrence of overweight and obesity has been noted in most countries of the world. This relates not only to adults, but also the population at the developmental age. Nowadays, 22% of children and youths in the United States, 6–20% in Europe and 2.5–15% in Poland are overweight (Bielicki et al., 1997; Jeschke, 1972; Riebel, 1976). This is caused by an increased consumption of food and lower physical activity (Bielicki et al., 1981). These factors are listed as the most important, although there are a number of other factors which significantly contribute to the phenomenon of obesity in children and youths (Demuth, Wieliński, 2000; Jedlińska, 1987; Młyńska, 2000).

## Aim

The aim of the study is to compare the biological maturity of body mass at birth with development of obesity in children at pre-school age.

## Methodology

The study material includes retrospective data obtained from medical record books and data from measurements carried out in 2007 on 62 girls and 58 boys aged 3 to 6 years in one of kindergartens in Poznań (Poland). The level of biological development was assessed on the basis of values of analysed morphological features (birth of body mass, actuality of body mass), and the state of perinatal maturity on the basis of foetal age and birth weight.

The degree of matching or discrepancy between calendar age of an individual and the weight age was established by assessment of “an individual’s place” within “a biological reference system” – a developmental standard of children population in Poznań.

The weight age of the birth weight and the current weight of child was assessed. The level of biological development was assessed on the basis of Biological Maturity Indicator for the birth weight and for the current weight of the studied children ( $W_{BM} = [\text{developmental age of body weight} \times 100 / \text{calendar age}] - 100$ ). The values of the indicator between  $-20$  and  $+20$  indicate normal biological development, values lower than  $-20$  – delay, and values higher than  $+20$  – acceleration in the biological development in terms of a given morphological criterion (in this case, the weight) (Cieřlik et al., 1994).

The studied children were classified into groups by gestation age:

- 1) born prematurely – before the end of week 36 of pregnancy;
- 2) born at term – from week 37,

and groups distinguished by the current weight:

- 1) low weight – delay in development of weight –  $W_{BM} < -20$ ;
- 2) normal weight – normal development of weight –  $W_{BM} = -20 \text{ to } +20$ ;
- 3) high weight – accelerated development of weight –  $W_{BM} > +20$ .

A group of accelerated biological maturity in terms of morphological age criterion was indicated on the basis of division into categories of children born with:

- 1) low weight for their gestation age – delay in development of weight –  $W_{BM} < -20$ ;
- 2) weight appropriate for their gestation age – normal development of weight –  $W_{BM} = -20 \text{ to } +20$ ;
- 3) high weight for their gestation age – accelerated development of weight –  $W_{BM} > +20$ .

The numbers and percentage frequency of representatives of the distinguished groups were also compared.

## Results

The analysis of the material indicates (Table 1, Fig. 1) that in the group of female premature newborns 3.2% are babies whose weight is too high. In the analysis of group of female newborns born at term (Fig. 2) as many as 32.3% of female newborns with birth weight too high for their gestation age was noted. In total this accounts for 25.8% of girls with accelerated development of weight compared to peer population and the results of the  $W_{BM}$  indicators show accelerated biological maturity in terms of this morphological criterion in this group of subjects.

The same situation was noted in case of analysed birth weight of male newborns (Table 1). In the group of boys born prematurely (Fig. 3) 3.4% exceed the threshold of birth weight over the standard (values of  $W_{BM}$  over  $+20$ ). In the group of boys born at term (Fig. 4), similarly as for the girls, a clearly higher percentage (27.6%) with birth weight too high for their gestation age was noted. This also indicates accelerated biological maturity in terms of the adopted criterion.

Biological maturity of pre-school children ( $W_{BM}$ ) was then analysed in terms of morphological criterion of the current weight (Table 2). In the group of boys and girls at pre-school age with accelerated biological maturity in terms of weight ( $W_{BM} > +20$  – overweight and obesity) a large percentage of children whose weight was too high was noted (girls 24.2%, boys 19%). It was noted that children exceeding the birth weight threshold are characterised by an accelerated biological maturity. Currently 1.6% of girls born prematurely (Fig. 1) and 24.2% of girls born at term (Fig. 2) are overweight. For boys too high weight at pre-school age was noted in 1.7% of prematurely born (Fig. 3) and 19% of born at term (Fig. 4). This indicates overweight and obesity in studied children at pre-school age.

## Discussion

A measure of physical, biological maturity of a child is the state of his or her physical development, in other words the level of his or her development. The level of physical development of an individual can be deduced from the relation between his or her calendar age and so called “biological age”, often called “weight age” (Cieřlik et al., 1992).

The degree of matching or discrepancy between an individual’s calendar age and weight age is established by assessing “an individual’s place” in “a biological reference system”, commonly called a developmental standard. In this way the degree of developmental advancement of an individual is assessed.

Weight age – as opposed to calendar age – is a measure of biological maturity of a body, as it indicates the degree of advancement in the development of some features and systems of a body. An appropriate assessment of a child’s physical

**Table 1.** Birthhood and birth of body mass in preschool girls and boys

Group	Girls			
	early birth (up to 36 <sup>th</sup> week)		normal birth (from 37 <sup>th</sup> week)	
	n	%	n	%
birth of body mass low	5	8.1	9	14.4
birth of body mass average	4	6.4	22	35.5
birth of body mass large	2	3.2	20	32.3
Group	Boys			
	early birth (up to 36 <sup>th</sup> week)		normal birth (from 37 <sup>th</sup> week)	
	n	%	n	%
birth of body mass low	5	8.6	9	15.5
birth of body mass average	2	3.4	24	41.5
birth of body mass large	2	3.4	16	27.6

**Table 2.** Birthhood and actuality of body mass in preschool girls and boys

Group	Girls			
	early birth (up to 36 <sup>th</sup> week)		normal birth (from 37 <sup>th</sup> week)	
	n	%	n	%
actuality of body mass low	2	3.2	4	6.5
actuality of body mass average	8	12.9	32	51.6
actuality of body mass large	1	1.6	15	24.2

Group	Boys			
	early birth (up to 36 <sup>th</sup> week)		normal birth (from 37 <sup>th</sup> week)	
	n	%	n	%
actuality of body mass low	3	5.2	6	10.3
actuality of body mass average	5	8.6	32	55.2
actuality of body mass large	1	1.7	11	19.0

development should be based on his or her weight age, as only with an awareness of a child’s developmental age can we assess whether a child is developmentally (biologically) younger or older than the child’s calendar age would indicate. The assessment of a weight age of an individual comes down to indicating time when a phenomenon accepted as an assessment criterion of weight age occurred (in this report the criterion of morphological age, and the analysed biological feature was birth weight and current weight). So by assessing the weight age of a child we assess the degree of advancement, that is acceleration or delay in a given biological property. The degree of acceleration or delay is a consequence of a relation between a child’s calendar and weight age. Weight age is given in years or years and months. Very rarely does the calendar age agree with weight age. This discrepancy – quite frequent in individual groups of calendar age in the whole period of progressive ontogenetic development – is a normal occurrence, resulting from phenotypic differences between individuals in a population. Obviously, this discrepancy may be considered as normal, when the size of deviations between calendar and weight age is within acceptable physiological deviation, i.e. so called “biological reference system” which reflects the range of phenotypic normality of the population. If the size of deviations exceeds the range of physiological standard (below the 10<sup>th</sup> and over the 90<sup>th</sup> centile) we are dealing with acceleration or delay of biological maturity (Makałowska, 1992).

It is well documented that birth weight is one of the most significant predictors of physical development throughout infancy and childhood. In recent years, due to advances in peri- and neonatology, and particularly owing to progress in medical care, the survival rate of newborns with low birth weight has significantly increased (Gadzinowski et al., 2003). These infants may experience a different pattern of physical growth to those born with appropriate birth weight (Kosińska, Sitek, 2003) and

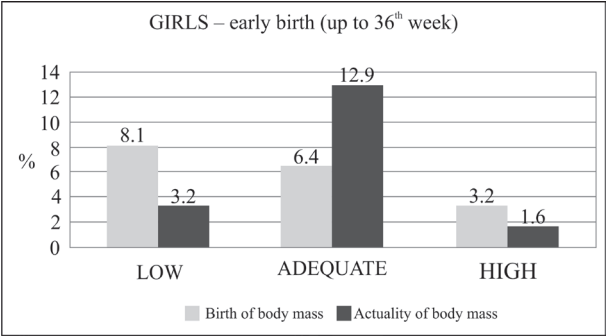
are more likely to remain underweight subsequently. The births of infants with birth weights less than or equal to 2500 g are correlated to the risk of deficient postnatal growth. There are numerous, often compounded, causes for delivery of infants with birth weights less than or equal to 2500 g. Depending on the cause for the occurrence of low birth weight, compensation of growth occurs at different times and with different degrees of probability (Kosińska et al., 2004).

The developmental (biological) age may be established on the basis of various criteria. We may use any biological feature, if only this feature shows clear differences in the course of progressive ontogenetic development in terms of improvement of its structure and function. The most frequently used indicators of developmental age are: 1) skeletal age, 2) age of secondary sex characters, 3) dental age, 4) morphological age, 5) physiological age.

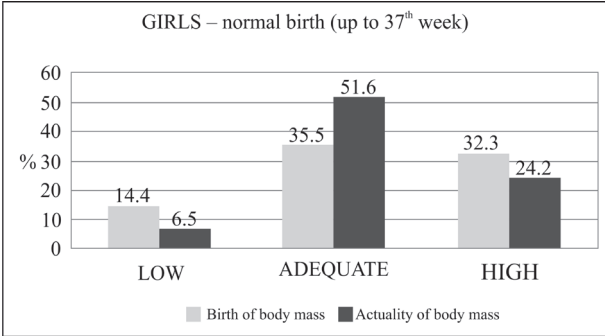
An objective measure of relation between the developmental and calendar age is an indicator of biological maturity ( $W_{BM}$ ) which expresses the relation of developmental age to chronological age (Cieślik et al., 1994).

For the purpose of this study an indicator of biological maturity was established for the morphological criterion ( $W_{BM}$  of weight). We are aware that in case of any developmental disturbances (mainly determined by disease factors) the developmental age of an individual should be established on the basis of a few criteria at the same time, e.g. morphological, skeletal criteria and criterion of secondary sex characters. The effect of environmental factors cannot be overlooked, in particular in case of obesity. More than 95% of obese children are affected by simple obesity, resulting from a positive energy balance. Its reasons include environmental factors: excessive consumption of food and small physical activity, reinforced by genetic predisposition to obesity (Bielicki et al., 1988; Bielicki et al., 1997). In this way the actual relations between these

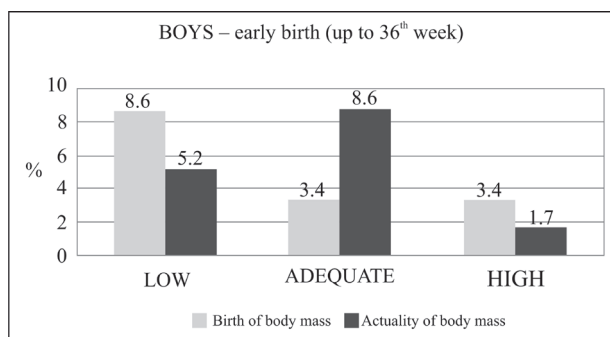
**Figure 1.** Graphic presentation of frequencies in separated groups of girls – early birth



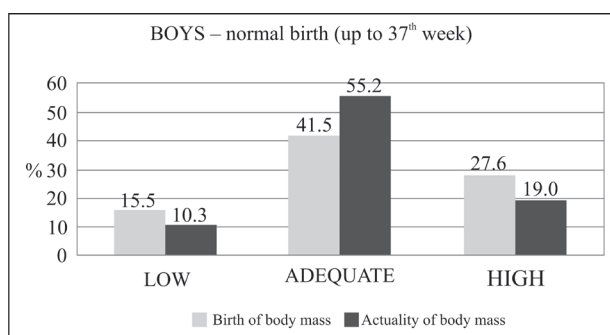
**Figure 2.** Graphic presentation of frequencies in separated groups of girls – normal birth



**Figure 3.** Graphic presentation of frequencies in separated groups of boys – early birth



**Figure 4.** Graphic presentation of frequencies in separated groups of boys – normal birth



indicators of developmental age and type of disturbance can be established. It is not justified, in case of this study, to make general conclusions. On the basis of preliminary studies which we intend to continue in annual cycles, we are unable to carry out detailed, extensive analyses, and this report is an indication of a problem only.

### Conclusions

1. In the group of the studied children those born prematurely are a small percentage. In this group the majority are those with low birth weight, and those with normal and high birth weight account for a small number. In the group of children born at term – most children are those with correct birth weight, followed by those with high birth weight, and those with low birth weight.
2. In the course of children's development a process of compensation of deficiencies and excesses in weight takes place. The number of underweight and overweight children decreases – the number of children with normal weight increases. This relates in the same way to prematurely born children and children born at term. The basis for the noted compensation effect may be: appropriate paediatric care, improved dietary habits of the Poles, appropriate physical activity in kindergartens. It seems that significant compensating role should be played by kindergarten which should vary meals individually in terms of their calorific content and composition, whereas it treats all children in the same way. Of course, appropriate range of physical activity on offer is also significant.

### Literature

BIELICKI, T., SZKLARSKA, A., WELON, Z., BRAJCZEWSKI, CZ. *Nierówności społeczne w Polsce: antropologiczne*

*badania poborowych w trzydziestolecie 1965–1995. Monografie Zakładu Antropologii PAN, Wrocław: 1997.*  
 BIELICKI, T., WELON, Z., WALISZKO, A. *Zmiany w rozwoju fizycznym młodzieży w Polsce w okresie 1955–1978. Monografia Zakładu Antropologii PAN, Wrocław: 1981.*  
 BIELICKI, T., WELON, Z., ŻUKOWSKI, W. *Problem nierówności biologicznej warstw społecznych. Mat. i Prace Antrop.*, 1988, no. 109, p. 123–140.  
 CIEŚLIK, J., KALISZEWSKA-DROZDOWSKA, D., KACZ-MAREK, M. *Dziecko poznańskie '90. Poznań: 1994.*  
 CIEŚLIK, J., PODGÓRSKI, M., RAFIŃSKI, M. *Biologiczny sens cechy. Możliwości interpretacji. Piontek J. (red.): Pojęcie cechy w naukach biologicznych. Poznań, 1992, p. 63–74.*  
 DEMUTH, A., WIELIŃSKI, D. *Czynnik rodzicielski a poziom dojrzałości biologicznej dziecka. Scripta Periodica, Warszawa, 2000, vol. III, no. 2(1), p. 255–257.*  
 FALK, C., FALK, S., STROBEL, E. *Overweight newborn infants-incidence, causes and clinical significance. Geburtshilfe Frauenheilkd.* 1989 Jun; vol. 49(6), p. 536–41  
 FUCHSOVÁ, M., OLÁHOVÁ, A., NEŠČÁKOVÁ, E., PREDNÁ, E. *Telesná charakteristika novorodencov s nízkou porodnou hmotnosťou. Česká Antropologie*, 2008, vol. 58, no. 1, p. 11–13.  
 GADZINOWSKI, J., KALISZEWSKA-DROZDOWSKA, MD., KOSIŃSKA, M., MAZELA, J., STOIŃSKA, B. *Urodzeniowa masa ciała a wiek płodowy noworodków regionu Wielkopolski i Ziemi Lubuskiej. Gin. Pol.*, 2003, vol. 74, no. 3, p. 186–192.  
 JEDLIŃSKA, W. *Wpływ niektórych czynników środowiska społecznego na wysokość i masę ciała dzieci szkolnych w Polsce. Prz. Antr.*, 1987, vol. 51, no. 1–2, p. 15–37.  
 JESCHKE, K. *Ist die Landschuljugend sportmotorisch Leistungsfähiger als die Stadtschuljugend? Leibesübungen*, 1972, no. 7, p. 146–149.  
 KOSIŃSKA, M., SITEK, M. *Description of human growth using mathematical models. 2003, Proceedings of the 8th National Conference on Application of Mathematics in Biology and Medicine, p. 91–96.*  
 KOSIŃSKA, M., STOIŃSKA, B., GADZINOWSKI, J. *Catch-up growth among low birth weight infants: Estimation of the time of occurrence of compensatory events. Anthropological Review*, 2004, vol. 67, p. 87–95.  
 MAKALOWSKA, I. *Cecha – jej wartość biologiczna. Piontek J. (red.), Pojęcie cechy w naukach biologicznych. Poznań, 1992, p. 135–143.*  
 MŁYŃSKA, D. *Rozwój biologiczny dziecka w wieku przedszkolnym na tle uwarunkowań środowiskowych. Scripta Periodica, Warszawa, 2000, vol. III, no. 2(1), p. 322–337.*  
 RIEBEL, H J. *Zur Fragm. Von Zusammenhängen und Unterschieden des motorischen Persönlichkeitsbereiches bei schulpflichtigen Stad-und Landkindern. In: Education physique des enfants avant l'époque de la puberté. PWN, Warszawa-Poznań: PWN, 1976.*